FOOD OF THE GREY MULLET *MUGIL CEPHALUS* (L.) FROM THE GOA REGION

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**ABSTRACT**

From the analysis of gut contents of grey mullet *Mugil cephalus* L., the food preferences of the size range 98 mm to 415 mm were determined. Algae and diatoms in fresh and decaying state and organic matter appear to be the favourite food items of mullet in marine, estuarine and riverine environments of Goa. Foraminifers and copepods form a small fraction of the stomach contents. Small quantities of gill rakers were observed in a few cases.

There was a remarkable increase in the intensity of feeding from October to February when algal blooms occur in the environment. The food intake declined during the monsoon months when the water was highly turbid with a heavy silt load.

**INTRODUCTION**

The grey mullet *Mugil cephalus* L. is a widely distributed fish in temperate and tropical waters. It is euryhaline and fairly resistant to changing temperature. It is widely used for culture both in brackish and fresh water ponds and is likely to play an important role in the future utilization of wet lands for aquaculture. A study of the food and feeding habits of this species in the natural environment of Goa was considered desirable in view of its future culture in the Goa region.

The food of the early juveniles of grey mullet was investigated earlier by several authors in different parts of the world (Egusa, 1950; Thompson, 1966; Liao, 1969 and 1975; Odum, 1970; Kuo, Shehadeh & Milisen, 1972; Zismann, Berdugo & Kimor, 1975). A number of workers have also studied the various aspects of food and feeding habits of the adult grey mullets in India. Mention may be made of the contributions of Bapat and Bal (1952), Pillay (1953), Sarojini (1954) and Kurian (1975). Most of these authors reported that grey mullets are plankton feeders and omnivorous in habit. Luther (1962) studied the food of grey mullets using the “index of preponderance” and reported that food consists of foraminifera and gill rakers of its own which have been shed. The feeding of fine sand grains particles by *M. Cephalus* and other fishes and prawns have been reported by various authors (Wood, 1964; Odum, 1968; Jacob and Qasim, 1974).

**MATERIAL AND METHODS**

To study the food of *M. cephalus*, stomach contents of 707 specimens in the size range of 98 mm – 415 mm were examined for a period of one year, from October 1975 to September 1976. Fish were collected in a fresh condition from different habitats of Goa, namely, the coastal areas (Baga, Anjuna, Calangute, Colva and Baina beaches), estuaries (Chapora, Talpona, Siridao, Galgibag, Mandovi and Zuari), and fresh water sources at (Raibandar, Old Goa, Durbar, Sanvor-dem, Palegaon and Panchavadi). Samples were obtained from beach seine and cast net catches.
The specimens were properly cleaned and the total length, weight and sex of each fish was determined. The degree of fullness of stomach was classified as gorged, full, 3/4 full, 1/2 full, 1/4 full, trace and empty. Each stomach was then allotted a certain number of points based on its fullness such as 100, 80, 60, 40, 20, 10 and 0 points. From the values obtained for each fish monthly averages were computed and the percentages calculated. The stomach was then separated from the intestine and rectum, and preserved in 5% formaldehyde solution for further examination.

Different workers have adopted different procedures for the analysis of stomach contents of fishes. In the present investigation, food analysis was done by the volumetric method. The stomach contents were collected in a petridish and analysed by allotting points. The latter was done by taking into consideration the magnitude of each item according to the distension of the stomach and the amount of food contained in it. The contents of the stomach and the rectum were separately examined under a microscope. The volume of food item was calculated from the total points of all the items, over the whole period. Fishes with stomachs "gorged", "full" and "3/4 full", were taken to have been feeding actively. Similarly, the stomachs "1/4 full" containing "traces" or "empty" indicated reduced feeding. Monthly percentages of the occurrence of stomachs with active or reduced feeding conditions were utilised to determine the seasonal fluctuations in feeding intensity. The percentage occurrence of the stomachs in different feeding conditions over the whole period was calculated.

**COMPOSITION OF FOOD**

The data of the stomach contents of the fish collected from the marine, estuarine and riverine environments during different months, are presented in Figs. 1-3. The volumetric composition makes it evident that the decayed organic matter, blue-green algae, diatoms, foraminifers and copepods are the most important food items of the fish. But in a few cases fragments of the gill raker process were also met within small quantities in the estuarine fishes in the winter months. Taking the average from the three environments, it is seen that decayed organic matter formed 37.6% of the stomach contents and thus ranked as the most important item of food. In the estuaries of Goa, usually there are thick deposits of silt containing considerable quantities of decaying organic matter. Fish, feeding at the bottom in these areas can, during most of the year, ingest a fair amount of fine silt.

Blue-green algae figure next in importance, forming a total of 17.8% of the gut contents. Both unicellular, and multicellular algae were consumed. The common constituents of this item were different species of the genus Oscillatoria. These were found almost throughout the year in the stomach contents. In the Zuari, Mandovi and Chapora estuaries, the substrata are composed of soft mud and in many places extensive mud flats are seen exposed at low tides. Thick growth of algae and diatoms occur on these mud flats and from the gut-contents it appears that the *M. cephalus* feeds on these mud flats. Algal spores were found occasionally in small numbers, especially in the months of August and September. Blue-green algae belonging to the family Cyanophyceae or Myxophyceae and genera Chroococcus, Phormidium, Microcoleus, Trichodesmium, Merismopedia, Lyngbya, Spirulina, Aphanthece were common.

36
Diatoms, on the whole, formed 10.8% of the gut contents of the fish. These were invariably found along with sand grains and decayed organic matter, indicating that they are consumed from the bottom. Several species of diatoms belonging to 12 genera have been identified. Of these *Pleurosigma*, *Navicula*, *Nitzschia* and *Cosinodiscus* formed the most important genera, whereas *Grammatophora*, *Diploneis*, *Pinnularia*, *Cymbella*, *Amphiprora*, *Melosira*, *Rhizosolenia*, *Chaetoceros*, *Thalassiothrix*, *Thallasionema*, *Triceratium*, *Biddulphia*, *Hemiaulus* and *Hemidiscus* were next in importance. Probably the diatoms were also ingested when the fish was feeding at the bottom.

Foraminifera formed 2.09% of the food consumed. Foraminifera upto genus level was identified. Of these, *Operculina*, *Anomalina*, *Elphidium*, *Rotalia*, *Quinqueloculina*, *Triloculina* and *Epinoides* were of importance. *Spirorolculina*, *Lagenula* and *Spirillina* were also noticed occasionally. Besides these, there were other unidentified foraminifers of minor importance.

The percentage composition of copepods in the food contents was 1.71, consisting of mainly *Metisjoussanneae* sp., *Microstella rosea*, *Harpactiens* spp., *Schmackeriagracilis*. Of these, the first three were the common. Occasionally, *Pseudodiaptomus serricadatus* was found in the stomachs of larger fish. The fact that copepods form a small fraction of the stomach contents and occur without any regularity in the different months (Figs. 1–3), indicates that they are probably swallowed along with other material accidentally.

The rest of the gut contents included sand grains, amounted to 29.93%. The sand grains occurred in the stomach contents together with minute quantity of sponge spicules. Presumably while browsing on the bottom, these were swallowed along with the algae, decaying organic matter etc. Moreover, sand grains were found throughout the year in the fishes collected from all the three environments, namely, marine, estuarine and riverine. In addition to these, dinoflagellates such as *Ceratium* and *Peridinium* were very often found in the stomachs but previous authors have not mentioned any dinoflagellates in the gut contents of mullet studied by them.

**Seasonal fluctuations in the composition of food**

The percentage composition of each item of food in the diet of the fish during the different months of the year (Figs. 1–3) indicated marked variations.

**Decaying matter**— This formed a major part of the food item throughout the year. The fluctuations in the percentage occurrence of major food items and quantities varied with the environment. In specimens obtained from the marine environment the quantity was low in May and June, and also in specimens collected from the riverine environment in the months from November to March. But it was uniformly present throughout the year in specimens from the estuarine area.

**Algae**— Maximum quantities of algae were found in the months of January and February in fishes caught from the sea as well as from the estuary, whereas in the riverine fishes this condition was recorded from October to January. But the percentage was minimum in marine fishes in April and May months, and in estuarine fishes it extended upto June.

**Diatoms**— The highest percentage of diatoms were recorded in December and January in fishes caught from marine and
Fig. 1. Percentage composition of food of *M. cephalus* collected from the sea.

Fig. 2. Percentage composition of food of *M. cephalus* collected from estuaries.
Food of the grey mullet *Mugil cephalus* (L)

![Food composition chart](chart)

Fig. 3. Percentage composition of food of *M. cephalus* collected from rivers.

Estuarine areas. In the case of riverine fishes this condition was noticed from February to April. The minimum value was observed in marine fishes in October, but estuarine fishes it was in the months of May and September. In riverine fishes, this condition was noticed during the period from September to November.

**Foraminifera**— Foraminifera which formed only a negligible percentage in the stomach contents was present throughout the season in riverine fishes. Their total absence was noticed in August and September in marine fishes and from December to February in estuarine fishes.

**Copepoda**— Like foraminifera, copepoda also constituted a negligible percentage. This group was absent in the stomach content of marine fishes during the period from August to October and in estuarine fishes from December to February. In riverine fishes their absence was noticed in the months of April and June.

**Sand grains**— The percentage composition of sand grains which also formed
Fig. 4. Seasonal variation in the feeding of *M. cephalus* in marine environment of Goa.

A major share of the stomach contents indicated that they were present throughout the year. But fishes from both marine and estuarine environments during the period from December to February recorded very fine sand grains only in lesser quantities.

**Seasonal fluctuations in feeding intensity**

The feeding intensity of *M. cephalus* in various months of the year from the marine, estuarine and riverine environments are presented in Figs. 4–6. Fishes were mostly caught at night during the high tide except those from the riverine areas which were fished either in the morning or in the evening. Thus the time of collection varied greatly in different areas.

Analysis of samples of fish obtained at regular intervals on the same day at different times and in different seasons showed that there is no marked variations in the intensity of feeding in relation to the time of the day. The data presented in Figs. 4–6 can, therefore, be justifiably employed to judge the feeding intensity of the fish in different months.

It is seen from the figures that most of the fishes were actively feeding from October to February in all the three environments. This appears to be an intensive...
Food of the grey mullet *Mugil cephalus* (L.)

![Chart showing seasonal variation in the feeding of *M. cephalus* in rivers of Goa.]

Fig. 6. Seasonal variation in the feeding of *M. cephalus* in rivers of Goa.

... reducing the overall availability of the food items.

**DISCUSSION**

From the data it is clear that the food of *M. cephalus* from the time they attain the fingerling stage largely consists of decaying organic matter, fresh and decomposing algae, diatoms, copepods and foraminifera. Earlier statement on food as "pliotrophic layer" (Sarojini, 1954) did not include any dinoflagellates which was frequently in the present investigation specially in the stomach of large sized fishes.

Zismann, Berdugo and Kimor (1975) reported that copepods were the most important food item in the gut contents of mullets at all times of the year and are consumed by fishes of all sizes. According to him smaller sized fishes feed on smaller copepods, while the larger sized fish feed on a wider range of sizes and species of copepods. However the present investigation indicate that although copepods are present in small quantities in the stomachs they have never formed the major food item at any time of the year.

The large quantities of fine sand grains present in the gut contents throughout the year in all the three environments show that the fish browses on the bottom mud and tiny particles of silt are ingested along with detritus and other food material. Wood (1964) demonstrated that small particles are far richer in nitrogen and phosphate than the larger material rejected by *M. cephalus*. Occurrence of fine sand grains in the stomach contents of striped mullet *M. cephalus* has been reported by Odum (1968) who observed that fine particles have significantly higher organic value than the coarser particles. The observation of Jacob and
Hari Pada Das

Qasim (1974) has also supported this view based on their studies on gut contents of the oil sardine and prawns.

Though only negligible quantities of gill rakers were observed in the stomach contents of *M. cephalus* during the present investigation, Luther (1964) has reported the habit of shedding gill raker process in grey mullets. He observed that this habit could be probably due to excessive feeding by the fish on its favourite item of food or due to the clogging of the branchial apparatus of the fish by the suspended particulate matter present in the environment.

Experimental as well as field studies of Pillay (1953), showed that grey mullet, *Mugil tade* prefer fresh or decomposing algae and when these are not available it subsists on decaying, macrovegetation.

The result of the stomach contents analysis during the present investigation makes it clear that the grey mullets have their stomach gorged with detritus indicating that detritus is its favourite food.

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References


Food of the grey mullet Mugil cephalus (L)


